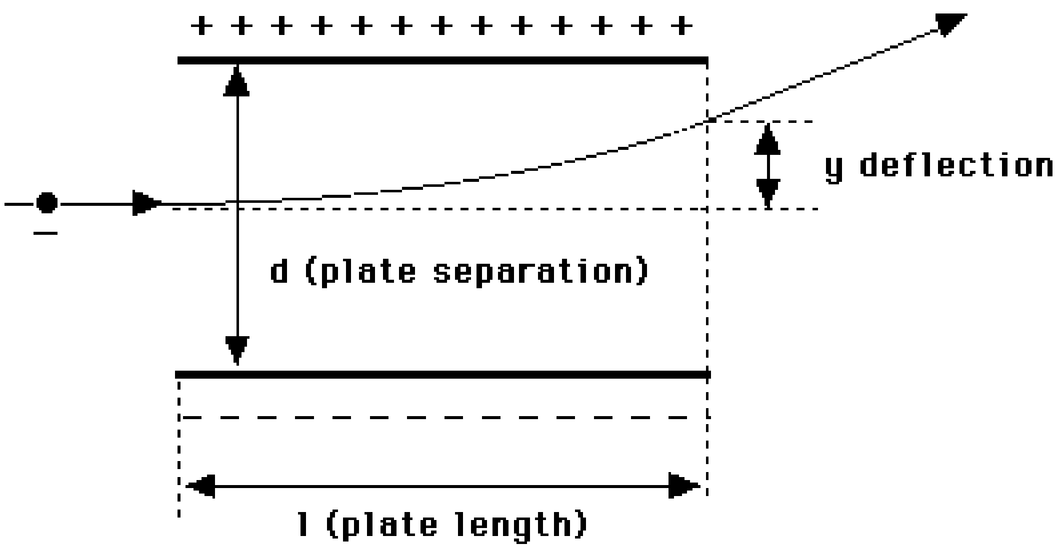
Projectile Motion in a Constant Electric Field

Now consider what happens when a charged particle enters the field between two charged plates from the side. Recall that the force on the charge is constant no matter where it is between two charged electric plates. If an electron travels horizontally through these plates, the electric force on the charge will act just like gravity acts on a projectile fired horizontally off a cliff - i.e. creating a **parabolic** path.

Examine the diagram below:



A force is exerted on the electron in the y-direction, upward (due to the electric field that acts *downward*). To determine the amount of deflection $\mathbf{d_y}$ that takes place, start with $\mathbf{F_y = ma_y}$.

Note that the electric force is the <u>only</u> significant force causing an acceleration in the y-direction, so that

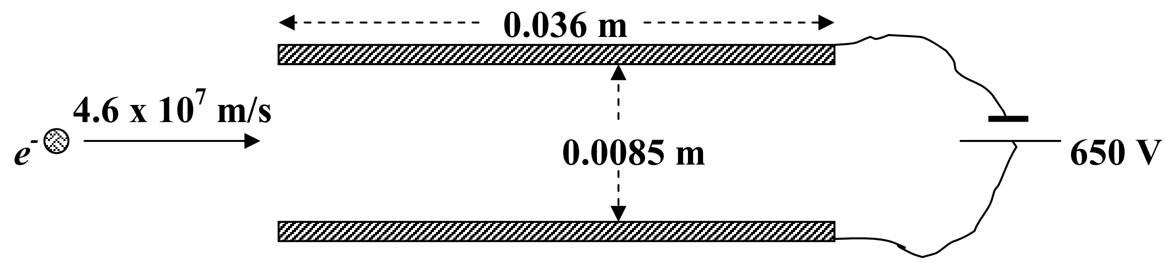
$$\mathbf{a_y} = \frac{\mathbf{F_y}}{\mathbf{m}}$$

→ substitute in $\mathbf{F_y = qE}$ and $\mathbf{E} = \frac{\mathbf{\Delta V_d}}{\mathbf{d}}$

where $\mathbf{\Delta V_d}$ is the <u>deflecting</u> voltage.

Solve for $\mathbf{a_y}$ and apply some kinematics (remember to list horizontal and vertical components separately) to determine the deflection $\mathbf{d_y}$. .

Example 15. An electron travelling at 4.6×10^7 m/s enters a constant electric field between two charged plates spread 0.0085 m apart, as shown below. The voltage between the plates is 650 V and the plates are 0.036 m long.



a) What is the electric force acting on the electron?
b) How much time is taken for the electron to pass through the plates?
c) How far will the electron "fall" from its path while in-between the two plates?

Hint: for b) and c), you'll have to examine horizontal and vertical components, just like for objects fired horizontally off a cliff.

(see Electrostatics Ex 15 for answer)